Center Innovation Fund: KSC CIF

Planetary Mobile Mining and Scalable In-Situ Water Extraction System for Mars Surface

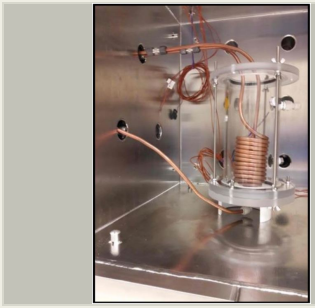
Completed Technology Project (2016 - 2017)

Project Introduction

Demonstrate processing cycle for extraction of water from all potential mineral sources without energy-intensive sublimation step to achieve larger-scale extraction. Also demonstrated energy efficient water mining concept by co-locating both regolith/ice excavation and water extraction within the Regolith Advanced Surface Systems Operations Robot (RASSOR) excavator rotating bucket drums. Reducing the energy requirements and enable scalable semi-continuous processing of water on Mars is a major challenge. Perform water extraction on the same robotic platform as the excavation. Perform literature research on large-scale terrestrial water-soil extraction methods and applicability to Mars case. Design processing cycle and identify appropriate technologies (resistive, microwave, recovered radiant heating).Design and build water extractor at reduced scale (~ 1L water) for testing in existing vacuum cryostat. Measure energy consumption, water losses, extraction yields, and quality of extracted water from representative simulants. Perform system performance trades on water recovery by sublimation and liquefaction by including end-to-end operations from excavation to water delivery to consumption point.

Anticipated Benefits

Develop and demonstrate a scalable, energy efficient in-situ water mining and extraction system. Current approaches to extract water from mineral resources in space have focused on a single thermodynamic route: collection of mineral – heat to sublimation of water and volatiles – water vapor and gas transport – condensation of water – removal of impurities from liquid water. This route is energetically costly because of the thermal energy required to heat the water-bearing minerals or ice frozen at very low temperatures (-50°C) to the sublimation point of water and then to overcome the large latent heat of sublimation.



Processing container for Mars Liquid Water Extraction in chamber.

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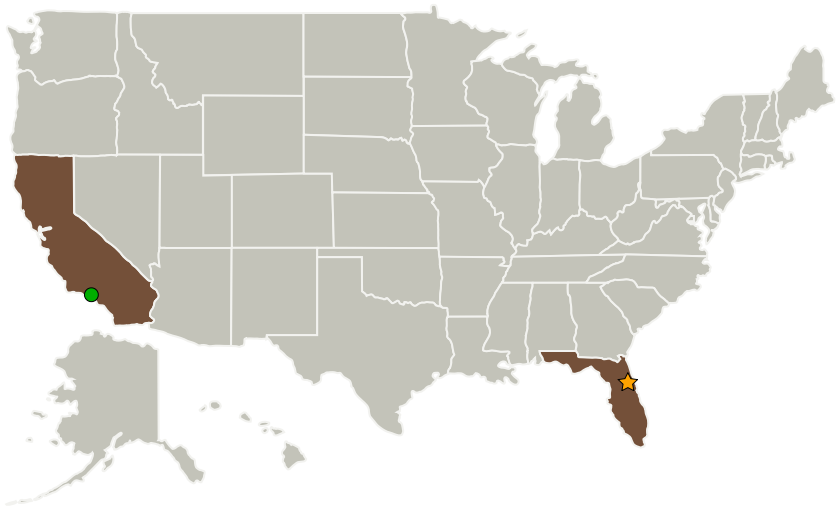
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida
Honeybee Robotics, Ltd.	Supporting Organization	Industry	Pasadena, California
●Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	Florida

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

Center Innovation Fund: KSC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

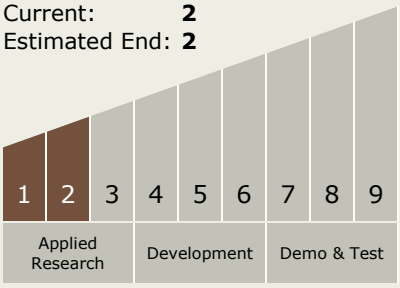
Barbara L Brown

Principal Investigator:

Robert P Mueller

Technology Maturity (TRL)

Start: **1**
Current: **2**
Estimated End: **2**



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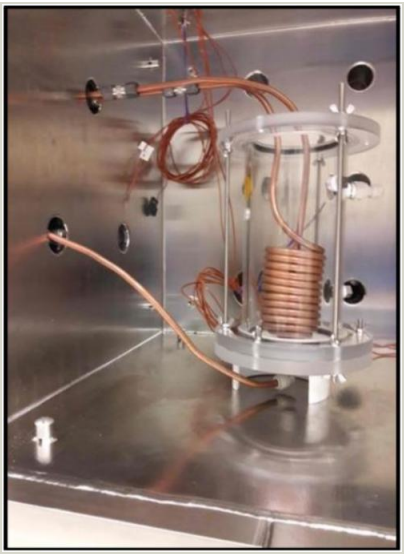
Images



Project Image
Processing container for Mars Liquid Water Extraction in chamber.
(https://techport.nasa.gov/image/35778)

Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.1 In-Situ Resource Utilization
    - TX07.1.2 Resource Acquisition, Isolation, and Preparation

Target Destination

Mars